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ABSTRACT

Drawing on the exam responses from a graduate teacher education course, this paper analyzes four general difficulties teachers have in implementing inductive teaching methods. Based on Piaget's model of how children learn, inductive teaching is an instructional methodology that begins with concrete instances of a concept, and encourages learners to observe patterns, raise questions, or make generalizations from observations. While teachers in the course appeared to grasp and use the basic learning cycle lesson planning methods for inductive teaching, their exams revealed the following difficulties: (1) failure to clarify lesson objectives; (2) over-emphasis on activities; (3) blurring conceptually distinct phases of the learning cycle, or omitting a phase; and (4) inadequate planning for evaluation, particularly of high level cognitive or affective outcomes of a lesson. Teacher education must require extensive practice, feedback, and coaching so that teachers can assimilate unfamiliar practices into their teaching behaviors. (BS)

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Conceptual difficulties in teachers' mastery of inductive teaching methods

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What causes the apparently poor reasoning and problem-solving skills of our students? What can be done to improve their skills?

Obviously in this brief paper I am not going to solve this incredibly complex problem. But in the short time we do have, I would like you to consider with me a part of the elephant that can be rendered edible if not easily digested.

I'll begin with some assumptions which I hope you'll accept for the sake of discussi[illegible]

1. That what teachers do in class, and what they have students do profoundly affects whether students will develop their reasoning skills;
2. That consistent practice over long periods of time in a variety of situations is necessary for the development of reasoning skills;
3. That the concrete nature of children's reasoning renders realistic experiences with concrete, manipulable objects a powerful medium for conveying concepts and relationships, and provides a strong foundation for later abstract reasoning;
4. That active, collaborative classrooms, designed to capitalize on children's interests and curiosity, are the ideal setting for development of problem-solving, ability, social skills, and a passion for learning.

You'll probably note a Piagetian bias in all this, the natural result of my background in Developmental Psychology. I've studied reasoning skills and learning processes of both children and adults, and have found concreteness to be a natural starting point for almost anyone, especially when learning a new subject or

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approaching a familiar subject in a new way. For my present purposes, "inductive teaching" refers to an instructional methodology that begins with concrete instances of a concept, and encourages learners to observe patterns, raise questions, or make generalizations from observations. Concept labeling follows concept understanding, providing means for students to symbolize their experiences and new learning. Let's turn, then, from these abstractions to a familiar situation: That of teaching teachers to teach.

The assumptions listed above form the basis of a three credit graduate teacher education course which I have now taught three times over the past four years. Each time, I have become more concrete and focussed in my attempts to help students understand the teaching implications of Piaget's theory. In the most recent section, we balanced reading and talking about Piaget's theory with reading about, experiencing, and designing "learning cycles"--inductive lessons based on Piaget's model of how children learn. The Learning Cycle typically includes three phases:

>An exploratory phase, structured to encourage students' involvement and stimulate their curiousity (usually referred to as "the Exploration");

>A Concept Introduction phase, in which observations are studied and conclusions drawn from them, and where explanations, terminology, rule statements and other symbolic representations of concepts to be learned are introduced (referred to variously as the Invention, Concept Introduction, or Explanation phase);

>A consolidation or generalization phase, in which the newly acquired ideas are explored in a new context (referred to as the Application or Extension phase).

The text for our course also included an Evaluation phase in which the students'

understanding and the success of the lesson are assessed.

The course was literally saturated with learning cycles; even the text (Bybee and Sund, 1982) is organized in "cycle" format, as well as teaching about learning cycles directly. (One criticism is that the authors present very few actual examples of learning cycles, other than their use of the 4-phase version to organize most chapters and the book as a whole.) We also studied general design principles useful in creating good cycles: Dialog, Concreteness, Inquiry Structuring, Sequencing, and Perspective-taking (Kurfiss, 1982).

The results of this effort were, overall, very satisfying. Students reported a sense of mastery and "in-groupness" in having a clearer idea of what Piaget REALLY said. They generally enjoyed the class, becoming actively involved and noting that time passed quickly. Ratings (based on the Kansas State IDEA system) were consistently in the high average category (70-90%), or above, for both "all course" and "similar course" categories. What, then, did they LEARN? And how will it affect their teaching behavior?

I'm pleased to report that everyone in the course was able to grasp and use the basic learning cycle model and the six principles of design. On the final exam, which required design of a single lesson, nine of the ten students correctly applied the basic concepts. The lessons were generally concrete, purposeful, collaborative and in some cases quite imaginative. But as I read through the exams and reviewed various projects completed during the term, I noticed some problems which led me to the idea of creating a taxonomy of conceptual difficulties in lesson planning, difficulties which could conceivably affect a teacher's success in using this innovative technology, and perhaps others as well. These problems seemed common enough to warrant close analysis, as a step toward anticipating and working to prevent problems resulting from teachers' limited grasp of strategies for motivating and involving students in an active learning community.

My analysis led me to formulate four general kinds of problems--not 100% distinct, but enough to serve as a starting point for discussion. I'll describe each briefly, give examples and speculate on consequences for these teachers' pupils. My purpose here is not to be exhaustive but to encourage teacher educators to consider possible cognitive sources of our current problems.

1. Failure to clarify lesson objectives

Apparently it is unwise to assume that practicing teachers have mastered the deceptively simple skill of identifying the instructional objective(s) of a lesson plan.

Although all but one of my 10 students included a formal statement of objectives, the majority had poorly formulated objectives in one or more of their assignments. For example, students listed objectives that described what would be done in the classroom, as opposed to the behavioral outcome for the learners (i.e., "to give a basic unit on...," "to teach children about...," or "students will participate in...," "will produce," "will be encouraged to think in new ways," "will discover how to..." and "will experience...").

Some were vague: The student "will increase or improve skills in..."; student "will become more knowledgeable about..." or affective: The student "will be comfortable in...," or "will gain confidence in..." Some listed a variety of objectives, and then lost sight of all but one or two in the actual lesson. The one student who consistently did not formulate objectives simply described one lesson as "an historical comparison," and then explained the specific point he hoped students would arrive at. Though some broad concepts were a logical extension of his point, he failed to note whether he planned to draw those out; as we shall see later, his lack of a clearly identified outcome causes difficulties in both lesson design and evaluation.

In all, only five lessons included outcome-centered behavorial objectives

at a level appropriate for their purposes. The possible consequences of a lack of clarity at this stage in lesson planning include a lack of student awareness of the purpose of the lesson and a lack of focus in the lesson itself. In several cases this showed up immediately in an overemphasis on what the children will do, described in the next section.

2. Over-emphasis on activities

Lack of concrete specification of learning outcomes can easily result in a corresponding lack of focus in selection or design of learning activities. Problems in writing objectives have a way of affecting the entire lesson plan, although even with good objectives, some teachers have trouble in focussing activities. In the present case, either students planned a string of loosely related activities, or they structured activities but failed to provide for closure. In the learning cycle model, closure is obtained through clearly highlighting (in the Concept Introduction phase) the concepts to be learned, and through providing opportunities for students to extend or generalize from newly acquired knowledge or skills (in the Application phase).

One teacher, who listed four student and two teacher objectives, planned a lesson for 9-12th graders which she would use when substituting (presumably during a one-hour time block). In this lesson she proposed to improve a familiar skill, using all of the following activities:

a mini lecture with visual support;
a values clarification sequence, including
>a demonstration followed by questions;
>a puzzle to solve, first alone, then in pairs, first back to back, then face to face;
>a question session (with very leading questions);

another mini-lecture and a one-page letter to be read;

an audio tape and continuation of the lecture;

a dialog asking for students' ideas;

a role play from these ideas;

a mini-lecture on using the ideas generated by the class; and

another tape followed by discussion of seven fairly high level, open-ended questions.

The students actually had only minimal opportunities to rehearse the skills or use the ideas being taught; for example, two of them participated in a role play, and at the end of the class, those who spontaneously used one of the skills in question received a piece of candy. Although one objective was to improve these skills, the lessons actually emphasized only the motivational aspects mentioned as a secondary objective. I would speculate that this type of instruction might motivate some students but would most likely not significantly enhance the majority of learners' skills.

In another instance, the teacher treats "doing" a process as equivalent to "increasing skill," in this case, in oral communication. No provisions for feeback are given in the lesson plan; simply talking once in front of the class (as spokesperson for a work group) is treated as if it were sufficient for the desired improvement to be obtained. Another problem arising from her lack of specificity is that upon completing fairly open-ended, non-evaluative group work and presentations, students are introduced to group process concepts. But when they shift to the application phase, their task is to make up a toothpaste commercial, perform it, and get a rating from their group on creativity, entertainment, and role play skills--not group process! Later they repeat this process in front of a video camera (with a reminder about group process skills). This lesson has the advantages of small group work and lots of practice, but without some helpful, carefully structured, feedback-oriented discussion of one's presentation and an

opportunity to try again (possibly holding presentation content constant), the experience will probably not have much impact on skill development. It might have a cumulative impact on "comfort" (a primary objective) but some children may be giving themselves so much negative feedback, or getting so much of it from unkind peers, that the net effect could in fact be negative. Similarly, without opportunity to reflect further on the group process, most students will not spontaneously symbolize their group experience, relate it to future experiences, and develop a conscious perspective on it. In Piagetian terms, they will not "decenter" but will attend only to the concrete or affective aspects of the experience (e.g., emotional tone) developing no awareness of the various elements contributing to their sense of success, failure, or neutrality. By focussing on some specific objectives (for example: "students will identify three elements of a successful short talk and will be able to use those elements to plan, present, and evaluate their presentations"), the teacher could have enhanced learning, fostered the children's analytical skills, and provided powerful tools and experiences to counteract their egocentrism.

This teacher also offers a writing lesson using "synectics," a creativity-enhancing program. The students do a variety of "right-brain" activities and each produces a short creative essay, but the lesson fails to make its implied point: that creativity can be tapped through a variety of devices and used to stimulate the writing process (or other problem-solving processes, for that matter). The point is not made because a) the students are not asked to write on the topic <u>without</u> preparation--for later comparison purposes in what could be a very fruitful, reflective discussion of both writing and creativity--and b) the teacher does not plan a follow-up that will help students identify other ways they can stimulate and use their creativity.

The allure of lively, enjoyable activities cannot be allowed to displace attention from the <u>purpose</u> of using concrete, experiential and collaborative

teaching strategies: To provide a concrete foundation on which the student can build formal, abstract, generalizable concepts.

3. Blurring conceptually distinct phases of the learning cycle, or omitting a phase.

The overemphasis on activities (and resultant lack of closure) described above constitute one kind of imbalance in the learning cycle, but here I want to discuss cases where boundaries between the phases are actually absent or confused, or where a phase is missing, slighted, or poorly handled.

In the simplest case, we have a teacher who in the invention or concept introduction phase simply tells the student the rule which his exploration was supposed to help them discover. Depriving students of the opportunity to consider the implications of their experiences and come to some tentative conclusions of their own renders the exploration meaningless (just a game to play before we get to the "real" stuff--the stuff that will be on the test!) and aborts students' own inquiry. It can also lead to a false sense of understanding (if they have a rule to write down and memorize, they "know" it), and the teacher loses valuable feedback regarding the effectiveness of the exploration in motivating inquiry.

Another misapplication of the learning cycle appears in what is no doubt a very provocative and engaging history lesson. The teacher (who offers no behavioral objectives) uses a strategy which involves getting students to raise a series of questions about his topic, which he, then, apparently answers. In each case, the task is described as "covering" certain material, though the mode is intended to be one of dialog. However, in this students' first class presentation, I observed that he not only used leading questions; he also tended to jump the gun by answering them before his simulated class (myself and the other students) had a chance to respond. I would speculate that his students sit transfixed, awed by his vast knowledge and enthusiasm for his subject, and that actual student-student and

teacher-student interaction is perhaps only slightly above average. A further concern is that because he focusses on the introduction of factual information and hs interpretation of it during the invention, broader implications are not explored as they might be. Rather than address the conflicts in students' feelings about our country's moral position and its implications, he goes on to raise more questions (from Hiroshima to My Lai, for instance) with no explicit plan for formulating central philosophical questions which might give students a framework for their own further thinking. Moreover, while students are asked (artificially, in my view) to come to consensus on why Truman really dropped the bomb on Hiroshima, they are not asked to reflect on the implications of their own disagreement and confusion, or the apparent lack of clear-cut knowledge about historical events. Because the teachers' biases appear to come through rather strongly, students may resort to "psyching out" what he wants them to say rather than wrestling with the complexity he presents, engaging in further research and dialog, and coming to grips with epistemological uncertainty. The result is likely to be either acceptance of the teacher's view as an authority figure and givers of grades (Dualism), or a shrug of the shoulders indicating that since no one knows, what difference does that make? It's "history," anyway, and one opinion (or guess) is as good as another (Multiplicity; see Perry 1970).

In a very different type of lesson, a math unit on multiplication, a fourth grade teacher shows more subtle difficulty with the model. She creates a valid exploration in which students, needing to clone a gumdrop turkey, discover a problem in adding up all the individual pieces to make 33 turkeys. I question two aspects of her presentation: a) she introduces ones-and-tens notation, substituting one large bean for 10 small ones to illustrate the concept. Why not let them simply group their small beans into tens and count by tens to arrive at both a final count and a clear concept of what that count means? b) For practice, the students go to a strictly paper-and-pencil mode, near as I can tell. No

gumdrops, no lima beans--just computations. In addition, for reinforcement, she stresses competitive speed drills (in teams). In her favor I must note that she has an "application day" each week where students use their newly acquired skills in realistic contexts such as bank accounts, grocery shopping, and planning for construction activities. These provide practice and give meaning to the skill itself--a rich and generally underused resource in all learning, not just as an afterthought.

One teacher uses a variety of techniques to help learning disabled students understand part/whole relationships, but has no specific concept introduction section where she provides terminology to help them symbolize this understanding and thus "store" it for transfer to other contexts. Another teacher uses two distinct activities in the exploration, one of which could easily be an application; and his application, in which students try out a new skill on their own, should probably be viewed as the evaluation phase. What he calls the Evaluation phase is, in fact, a description of the procedure by which the students' written work from the Application will be handled.

In another lesson plan, a chemistry teacher introduced additional "disequilibrating" experiences after the Exploration, in the Invention phase; his problem is traceable to a failure to sort out and sequence two related concepts he wanted to get across. Lacking room for the second concept in the Exploration, he siimply inserts it in the next phase. Learning cycles, like most lessons, work most effectively when only one concept is presented in the Exploration/Invention phase, though a new twist or related concept may be introduced in the Application. However, this phase should probably be reserved for consolidation of new learning--either as practice or generalizing its use to a new, somewhat similar siuation. Once the chem teacher was shown this problem, he was (like most of the others) willing and able to revise and strengthen his lesson plan into a very promising learning experience.

Without clarity about the sequence of activities and their purpose, lessons can only confuse and frustrate learners, leaving them to feel manipulated and "done to" rather than guided through a natural learning process. With too much going on and too little structure, it will be difficult for them to focus their attention on what is to be learned, and to construct well-connected frameworks for interpreting future experiences and new learning. These frameworks are necessary both for deductive learning and continued inductive learning.

4. Inadequate planning for evaluation, particularly of high-level cognitive or affective outcomes of a lesson.

Several of the teachers seemed at a loss to devise evaluation plans which would assess the higher-level thinking and problem-solving skills they hoped to develop. Again, the lack of well-formulated objectives limits their success, since without a behavioral statement of intent it is difficult to determine whether one's intent has been fulfilled. For instance, our history teacher, describing a lesson on the impact of large families on public education in Utah (the larger context being the collision of society's needs and religious values), plans to assess students through essays addressing the problem. The catch is that in these essays, he wants students to take one of two positions which he describes. He makes no statement to the effect that these posiions must be well argued or supported, leaving himself open to charges of bias in his grading.

Another teacher, who wants students to be able to explain an arithemetic procedure in their own words, asks them to do this informally, working in pairs and explaining to each other. But, again, no criteria are given to indicate what constitutes a satisfactory explanation (does the other child have to follow these instructions and correctly solve a problem?), and on the actual test, apparently only computations are given. In a lesson on the eye, designed to "teach children about their eyes...and why we should appreciate our sight," an elementary school

teacher tests only on the labeling portion of the lesson, stating with resignation "that the rest can only be measured by observing of a change in attitude that may or may not show up in the school setting."

When students experience a wide variety of activities but are unable to identify what is to be learned, the likely results are disappointing test performance, confusion, and frustration as they experience discrepancies between activities and their evaluation. And if they are only graded on the simplest, most "concrete" details of what is presented, they are likely to become cynical about their school experiences. Perhaps it is not surprising that so many college freshmen appear to expect multiple choice exams and are confused when asked to "think for themselves."

These examples illustrate difficulties that may arise when inductive (and possibly other innovative) teaching methods are taught to teachers primarily in the college classroom. They confirm my long-held suspicion that teachers do not teach or test for higher level thinking because they simply do not know how. The sources of this gap are undoubtedly numerous, ranging from the skill and intelligence level of students who select teaching majors to the quality of and focus of their training (recently attacked even by Newsweek!) and the attractiveness of teaching careers. Their persistence even in experienced and well qualified graduate student teachers provides support for Joyce and Clift's recent claim that effective teacher education requires extensive practice, feedback, and coaching so that unfamiliar strategies may be assimilated into the repertoire of teacher's everyday behaviors.

One thing is clear: if we want to develop children's thinking skills, we must teach and test for thinking. If that is to happen, teachers must be trained to include thinking skills in their lessons, to clarify their intentions, to design instruction that follows logically from their intent, to evaluate systematically the results of their instruction, and to use this information to revise and strengthen the effectiveness of their lesson plans.

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